

**STATUS OF *ELYMUS SIMPLEX* VAR. *LUXURIANS***  
**(LONG-AWNED ALKALI WILD-RYE),**  
**SOUTHWESTERN WYOMING**



Prepared for:  
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## ABSTRACT

Surveys were conducted for *Elymus simplex* var. *luxurians* (long-awned alkali wild-rye) in Sweetwater and Carbon counties of southwestern and south-central Wyoming, respectively. Potential habitat was surveyed throughout the Killpecker and Ferris Dunes. This report represents the results of the first systematic surveys, documenting it throughout the Killpecker Dunes. Only the type variety is present in the Ferris Dunes. *Elymus simplex* var. *luxurians* is locally dominant and widespread in the western portion of the Killpecker Dunes (Rock Springs Uplift), and more sporadic, though sometimes still common in the eastern portion of the Killpecker Dunes (Great Divide Basin). It is present in four giant populations that are shaping and in turn shaped by Killpecker Dune succession. It is the more geographically restricted of the two varieties, though the type variety is nearly restricted to Wyoming. There is little evidence to suggest that it is affected by local land-use practices including livestock grazing, oil and gas development, and ORV traffic. Current taxonomic treatment is presented, and background information and duplicate specimen vouchers were sought for context and advancing future work.

## ACKNOWLEDGEMENTS

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Cover page: *Elymus simplex* var. *luxurians* by B. Heidel

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## INTRODUCTION

*Elymus simplex* var. *luxurians* (long-awned alkali wild-rye) is endemic to Wyoming. Prior to this survey, it was known from six collection records that appeared to represent four areas in the Killpecker Dunes, all on Bureau of Land Management (BLM) lands. In addition, a collection had also been made from the Ferris Dunes and provisionally identified to this taxon, and the 1898 type collection appeared to have been collected outside the Killpecker Dunes. In 2010, it was added to the BLM Wyoming sensitive species list (USDI BLM 2010). *De novo* systematic surveys were conducted in the Killpecker and Ferris Dunes to evaluate the many factors that are addressed in determining conservation status.

## METHODS

At the start of this project, all specimens of *Elymus simplex* var. *luxurians* were reviewed to get a search image and information on its habitat and distribution, as represented by the Rocky Mountain Herbarium on-line database (2011). Then, an ArcMap project platform was set up, starting with bedrock geology mapping (Love and Christiansen 1985) to mark the extent of aeolian sand deposits. Within this area, each population was reviewed against public land maps and aerial digital ortho-photographs (NAIP imagery; photographed in 2009) to consider the pattern and extent of potential habitat. Only two recent collections (*Fertig 19168* RM, *Heidel 2815* RM) had detailed location information, and they were from interdunal swales. On ortho-photographs, these areas were identified as a discrete grey tone compared to surrounding active sands, often homogenous in texture, corresponding to interdunal areas paralleling the linear transverse dunes. A flagging point was digitized to tag every large area potentially meeting these criteria as warranting consideration for survey.

In preparation for fieldwork, digital ortho quarter-quads (doqqqs) with section lines, known distribution, and flagging points, were printed out onto 8 ½" x 11" pages of paper, representing about the same scale as 1:24,000 USGS topographic maps. The aerials and USGS maps were both used for reference in setting field survey priorities and navigation in the field.

Surveys for *Elymus simplex* var. *luxurians* were conducted by two people at a time, working between 23 June – 27 July 2011. When *E. s.* var. *luxurians* was found in a survey area, determinations were made of its extent, and characterizations were made of its environmental setting, vegetation, and plant associates. A single Geographic Positioning System (GPS) point was taken for subpopulations of 10 m radius or less. Otherwise multiple GPS points were taken. We did not try to determine stem numbers because the species reproduces vegetatively by rhizomes, and at varying density. Frequency was noted instead (uncommon, common, abundant/dominant). Sensitive plant survey forms were filled out, and later entered in the WYNDD database. Survey routes are represented in Appendix A, and also represented survey

routes for *Penstemon haydenii* (blowout penstemon). Duplicate specimens that represent *Elymus simplex* var. *luxurians*, *E. s.* var. *simplex*, *E. lanceolatus* var. *lanceolatus* and putative intermediates have been deposited at Rocky Mountain Herbarium and Utah State University.

## RESULTS - SPECIES INFORMATION

### Classification

Scientific name: *Elymus simplex* Scribn. & T.A. Williams ex Scribn. var. *luxurians* Scribn. & T.A. Williams ex Scribn.

The species and variety were first described in 1898 by Frank L. Scribner and Thomas A. Williams (Scribner and Williams 1898). The type was collected in 1897 (*Williams 2338* US), noted as “common near Green River, growing in rich soil along streams.” It was collected the same day as the type specimen for the species (*Williams 2334* US), noted as “on banks of Green River.”

The taxonomic concept of the species, *Elymus simplex*, was confused by Hitchcock’s treatment (1935) based on mixed specimens of both *E. simplex* and *E. salina*. He placed it as a variety of *E. triticoides*. It was reinstated at species level by Chase (1951), without taxonomic clarification, thus reported as having a distribution that included Colorado. The taxonomic record was set straight by Hatch (1976), and the species has been accepted by authors since.

The variety *Elymus simplex* var. *luxurians* was treated as a synonym of *Elymus triticoides* by Chase (1951). Though the variety was not included in Porter (1964), specimens at RM were later annotated to this variety by him. It was treated as not distinct from the type variety in Cronquist et al. (1977). This may be the reason it is treated as a synonym of *E. simplex* in the PLANTS database (USDA NRCS 2012). It was provisionally accepted in *Flora of North America* (Barkworth 2007), with a statement about the variety distinction: “The two may be environmentally-induced variants, but the lack of intermediates suggests a genetic distinction.”

Synonyms: *Leymus simplex* var. *luxurians* (Scribn. & T.A. Williams) Beetle; *Leymus simplex* var. *luxurians* (Scribn. & T.A. Williams) D.R. Dewey

The *Leymus simplex* species and its varieties have been transferred to the *Leymus* genus, a temperate genus that is most abundant in Asia, and present mainly on alkaline soils as it occurs in North America (Dewey 1983). A complete overview of the genomically based genera distinctions in the perennial Triticeae (*Elymus sensu lato*) is presented by Barkworth and Dewey (2011). This is the treatment followed in *Flora of North America* (Barkworth 2007), based on Barkworth and Dewey (1985). It splits off the *Elymus* genus *sensu stricto*, which remains the largest and most morphologically diverse genus within the tribe, representing species that are caespitose and self-fertilizing, with short anthers.

Common name: Long-awned alkali wild-rye

Family: Poaceae (previously referred to as Graminae; Grass Family)

Size of genus: The *Leymus* genus is comprised of approximately 50 species, all native to temperate regions in the Northern Hemisphere. There are 15 species in North America, plus two hybrids. Of the 15 species, seven occur in Wyoming (Barkworth 2007, Dorn 2001).

Phylogenetic relationships: All of the *Leymus* species are self-incompatible, out-crossing polyploids (Barkworth 2007). Chromosome data is not available for *L. simplex* var. *luxurians*, but the type variety has  $2n=28$  (Love 1980).

### **Present legal or other formal status**

U.S. Fish & Wildlife Service: None.

Agency status: Designated sensitive by Wyoming Bureau of Land Management (BLM 2010).

Global Heritage rank: G3T1T2. The rank indicates that the species is vulnerable (G3), while the variety is imperiled or critically imperiled (T1T2). Updating of the global rank was done as part of the recent species of concern list update (Heidel 2012a), in collaboration with NatureServe.

State Legal status: None.

State Heritage rank: S1S2. The rank indicates that it is imperiled or critically imperiled. Updating of the state rank was done as part of this project, and reflected in the most recent species of concern list update (Heidel 2012a).

### **Description**

General non-technical description: Long-awned alkali wild-rye is a strongly rhizomatous, perennial grass with whitish, bluish herbage, 4-7.5 dm tall. The 1-2 (5) mm wide blades are firm, flat, prominently-ribbed, becoming involute when dry, and hairless or with fine short or long hairs. The ligule is 0.3 to 0.5 mm long, squared off, and fringed with hairs. The spike is 10 to 27 cm long, and spikelets are 10-20 mm apart, solitary or some are in pairs on the lower part of the spike. Spikelets are mostly 18-30 mm long, with 6-12 florets per spikelet. Lemmas are 7-12 mm long and some have awns 7 mm or longer. The glumes are mostly subequal, 8-12 mm long, 0.5-1.5 mm wide and tapering (Barkworth 2007, Dorn 2001, Heidel 2012; Figures 1-4).

Technical description: Plants strongly rhizomatous, often glaucous. Culms (40) 55-75 cm tall, 1-2.5 mm thick, solitary, glabrous or sparsely pubescent near the nodes. Leaves exceeded by the spikes, sheaths glabrous, smooth, auricles infrequently present, ligules 0.3-0.5 mm, truncate,

erose, blades 4-9 cm long, 1-2(5) mm wide, flat, becoming involute when dry, stiff, adaxial surfaces scabrous, with scattered hairs to 2 mm, veins 7-11, subequal, prominently ribbed. Spikes 1.5-2.7 cm long, 4-5 mm wide, with 1 spikelet per node at midspike, sometimes with 2 at the lower nodes. Internodes 10-20 mm, surfaces glabrous or strigulose, edges ciliate, ca. to 1 mm. Spikelets 16-25 mm, pedicellate, pedicels 1-2(5) mm, with 6-12 florets. Glumes subequal, 8-12 mm long, 0.5-1.5 mm wide, subulate, tapering from about ¼ of their length, stiff, glabrous at least at the base, the central portion thicker than the margins, keeled, 0-1(3)-veined, veins inconspicuous at midlength. Lemmas 7-12 mm, glabrous, awned, some with awns 7 mm or longer. Anthers 3.7-4.5 mm, dehiscent (Barkworth 2007, Dorn 2001).

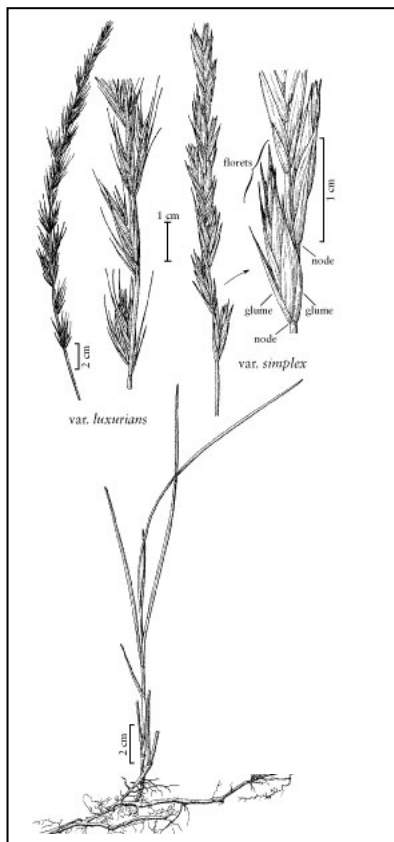


Figure 1. *Elymus simplex* var. *luxurians* and *E. s.* var. *simplex* illustration. By C. Roche. From: *Flora of North America* (Barkworth 2007)

Figure 3. *Elymus simplex* var. *luxurians* spikelets (close-up). Note paired spikelets throughout mid-spike.

<sup>1</sup> All photographs in this report are by B. Heidel.



Figure 2. *Elymus simplex* var. *luxurians* spike. Note single spikelets per node at mid-spike. Spikelets distinct, 10-20 mm apart. By B. Heidel<sup>1</sup>.







Figure 4. *Elymus simplex* var. *luxurians* spike (10-27 cm) and whitish, bluish (glaucous) leaves.



Figure 6. Plants that appeared intermediate between species or atypical were documented by specimens and photos.



Figure 5. *Elymus lanceolatus* var. *lanceolatus* in flower. Note the hairy, unawned lemmas, and the single spikelets at all nodes.



Figure 7. Pedicelled spikelets of *Elymus simplex* var. *luxurians*, atypical.

Table 1. Characteristics that distinguish *Elymus simplex* var. *luxurians* from other wheatgrasses in southern Wyoming<sup>2</sup>

Species	Growth form	No. of spikelets/node at midspike <sup>3</sup>	Length of spike (cm)	Glume shape	Spikelet length (mm)	Lemma tip	Lemma surface	In wetland habitat?	Other Characteristics / Notes
<i>Elymus albicans</i>	Rhizomatous	1	4-14	4-8 mm wide	10-18	Awns 4-12 mm	Glabrous or densely hairy	Y	Lemma with a divergent awn mostly 5 mm or more long
<i>Elymus cinereus</i>	Bunchgrass	2+	10-29	Subulate	9-25	Awn to 3 mm	Glabrous to hairy	Y	Leaf blades flat, often over 6 mm wide
<i>Elymus elymoides</i> var. <i>elymoides</i>	Bunchgrass	2+	3-20	Subulate	10-20	Awns over 3 cm, bent	Glabrous, scabrous, or appressed pubescent	Y	Rachis disarticulating when mature, one of the glumes at most nodes split into 2-3 divisions
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>	Rhizomatous	1	8-25	Lanceolate, and widest at or above middle	9-17	Awnless or short and straight	Moderately hairy, hairs stiff, less than 1 mm	Y	Perhaps the most common species in the area
<i>Elymus lanceolatus</i> var. <i>riparius</i>	Rhizomatous	1	6-10	Lanceolate, and widest at or above middle	10-17	Awnless or short and straight	Smooth	Y	More typical of mesic settings than the type variety
<i>Elymus racemosus</i>	Rhizomatous	2+	15-35	Subulate, 1-2 mm wide	12-25	Awn 1.5-2.5 mm	Glabrous distally, pubescent proximally	Y	Non-native; disturbed habitat
<i>Elymus repens</i>	Rhizomatous	1	5-15	Oblong	10-27	Awnless or short and straight to 3 mm	Glabrous	Y	Non-native; leaf blades flat, 5-10 mm wide, usually disturbed habitat;
<i>Elymus salinus</i> ( <i>Leymus salina</i> )	Bunchgrass or weakly rhizomatous (short, stout)	1(2)	4-14	Subulate	9-21	Acute or awned to 2.5 mm	Usually glabrous, sometimes strigillose	Y	
<i>Elymus simplex</i> var. <i>luxurians</i> ( <i>Leymus simplex</i> var. <i>simplex</i> )	Rhizomatous	1(2)	10-27	Subulate, but broadened and flattened at base	18-30	Awned, 2.3-6.5 mm	Glabrous	Y	Spike internodes 10-20 mm
<i>Elymus simplex</i> var. <i>simplex</i> ( <i>Leymus simplex</i> var. <i>simplex</i> )	Rhizomatous	1(2)	1.5-13	Subulate, but broadened and flattened at base	10-18	Awned, 2.3-6.5 mm	Glabrous	Y	Spike internodes 7-9 mm
<i>Elymus smithii</i> ( <i>Pascopyrum smithii</i> )	Rhizomatous	1	5-17	Narrowly lanceolate	12-26	Lanceolate, acute to awned	Pubescent	Y	Leaves less evenly distributed than <i>E. lanceolatus</i>
<i>Elymus spicatus</i> ( <i>Pseudoregneria spicata</i> )	Bunchgrass	1	8-15	Narrowly lanceolate, 0.9-2.2 wide	8-22	Unawned or with divergent awn	Glabrous	N	This species is the most restricted to upland settings of the species in the area.
<i>Elymus triticoides</i>	Rhizomatous	2+	10-22	Subulate	5-20	Usually awned, to 3 mm.	Usually glabrous, occasionally sparsely hairy	Y	Only known in WY from historic records

<sup>2</sup> The table is based on nomenclature in Dorn (2001), keys in both Dorn (2001) and Barkworth (2007), and descriptions in the latter.

<sup>3</sup> At least at middle of spike

Local field characters: *Elymus simplex* var. *luxurians* is a wheatgrass with an exceptionally long spike (10-27 cm; Figures 1-4). The widely-spaced spikelets are usually discerned, and the awns are distinct. Positive determination depends on technical characteristics (Table 1).

Similar species: The spikes of *Elymus simplex* var. *simplex* are 1.5-13 cm long, spikelets are 7-9 mm apart, and generally less than 20 mm long, including awns. *Elymus salinus* and *E. triticoides* have lemmas with no awns or awns less than 2 mm long; *E. triticoides* also has blades some usually over 3 mm wide, and spikelets that are usually paired at each node of the rachis. *Elymus lanceolatus* var. *lanceolatus* is hairy, generally unawned, with one spike per node (Figure 5). Hybrids are occasionally present (Figures 6-7).

**Geographical distribution**

Range: *Elymus simplex* var. *luxurians* is only known from the Killpecker Dunes of Sweetwater County, straddling the continental divide that separates the Rock Springs Uplift to the west from the Great Divide Basin to the east. It is 10.8-55 miles southeast of Farson that lies at intersections of Wyoming Highways 285 and 340 (Figures 8 and 9).

Figure 8 (right). Distribution of *Elymus simplex* var. *luxurians* in Wyoming

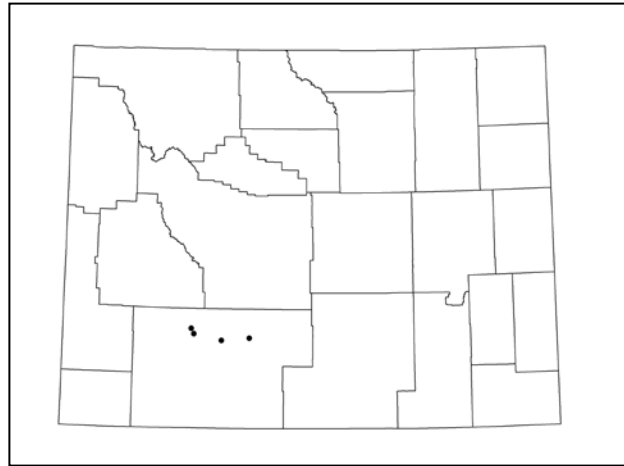
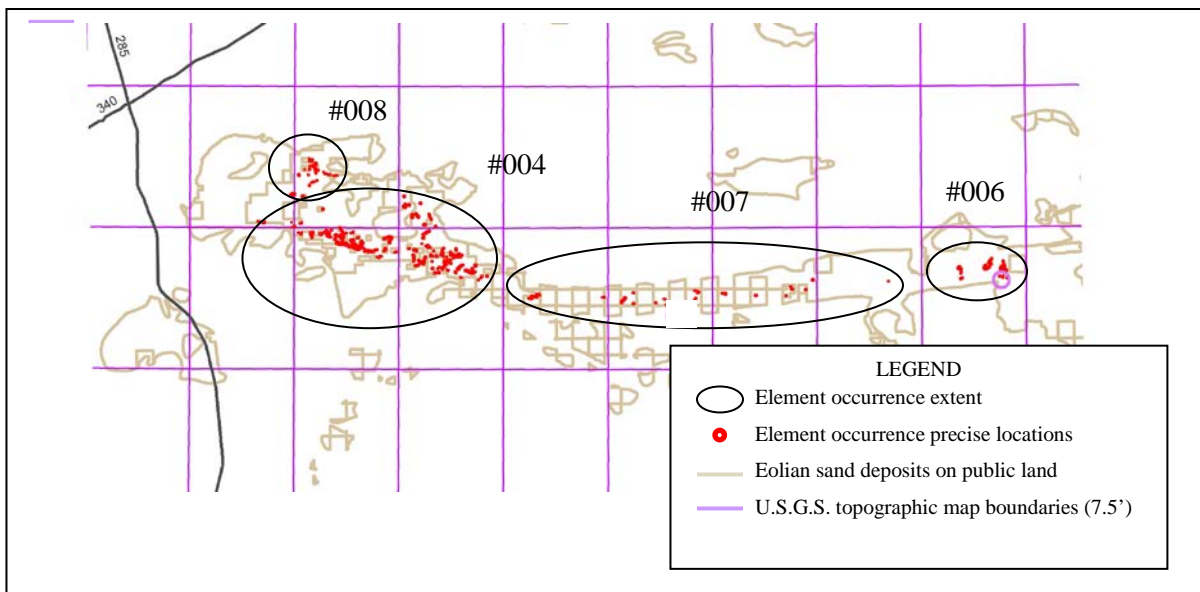


Figure 9 (below). Element occurrence distribution of *Elymus simplex* var. *luxurians*



Extant sites: *Elymus simplex* var. *luxurians* is known from four very large occurrences that span 80 sections at over 200 discrete locations (Figures 8-9; Table 2). The populations are separated by large areas of stabilized sand deposit, but all are essentially on the same wind stream and might represent a single giant population complex. All occurrences were surveyed in 2011.

The population mapping was not exhaustive, but covered over 25% of swales in any given area, and documented that it was present with high consistency in swales within the center of active dunes, especially in EO#004. An example of aerial imagery used in fieldwork (Figure 10) and resulting population maps (Figure 11) reflect the coverage of survey.

Historical sites: The type specimen of *Elymus simplex* var. *luxurians* was collected in 1897 “near the Green River” on the same day that other collections were made at the River. The Green River at its nearest point is about 30 miles west of the Killpecker Dunes but still in Sweetwater County. There are no known records for it from farther west in Sweetwater County, and it has not been surveyed in this area. This is a survey priority.

Table 2. Location of *Elymus simplex* var. *luxurians* populations in Sweetwater County, Wyoming

EO# <sup>4</sup>	Location	Legal Description	Elev. m (ft)	USGS 7.5' Quad	Agency
004	Rock Springs Uplift; Killpecker Dunes south of Jack Morrow Hills	T23N R103W Sec. 4, 5, 7, 8, 9, 10, 11, 14, 15, 16, 17, 21, 22, 23, 24; T23N R104W Sec. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18; T23N R105W Sec. 1, 3, 12; T24N R103W Sec. 29, 30, 31, 32; T24N R104W Sec. 26, 27, 28, 29, 30, 31, 32, 33, 34, 35.	(6840-7160)	Boars Tusk, Essex, Fifteenmile Spring, North Table Mountain, Ox Yoke Springs	BLM
006	Rock Springs Uplift; Killpecker Dunes between Red Lake and Chalk Butte	T23N R97W Sec. 17, 18, 20; T23N R98W Sec. 13, 14, 23, 24.	(6590-6620)	Red Lake	BLM
007	Great Divide Basin; Killpecker Dunes south and southeast of Steamboat Mountain	T23N R98W Sec. 19; T23N R99W Sec. 19, 20, 29, 30; T23N R100W Sec. 26, 28, 30, 31; T23N R101W Sec 25, 26, 28, 30, 35, 36; T23N R102W Sec. 28.	(6560-7200)	Black Rock Flat East, Black Rock Flat West, Black Rock North, Steamboat Mountain	BLM
008	Great Divide Basin; Killpecker Dunes west of Jack Morrow Hills	T24N R104W Sec. 17, 18, 19, 20, 21, 30; T24N R105W Sec. 24, 25	(6840-7100)	Fifteenmile Spring, Ox Yoke Spring	BLM

<sup>4</sup> Occurrence numbers start with #4 and are in a discontinuous series because there was merging of lower numbers and redetermination of specimens.

Unverified/Undocumented reports: There were two recent specimens of *Elymus simplex* var. *luxurians* collected near outside the Killpecker Dunes. One has been redetermined as the type variety (Fertig 16159 RM, Rock Cabin Springs in the Jack Morrow Hills). Another from the Ferris Dunes in the Rawlins Field Office was also redetermined (Heidel 2790 RM). Only the type variety has been found in more recent collections from the Ferris Dunes (Heidel 3543 RM).

Sites where present status not known: None. There are four collections of *Elymus simplex* var. *luxurians* in the Killpecker Dunes that did not have township-range-location information to quarter-quarter section (Nelson 31402, 36322 RM; Smith 1809 RM; Ward 1320 RM). The 2011 surveys covered all major habitat in the areas where the four were collected, including the same townships and sections they were originally collected. It is inferred that the collections correspond with some parts of existing distribution documentation.

In addition, there was a collection made in 2000 (Fertig 19168 RM) and the location for it was described to quarter-quarter section, but plants could not be relocated in the same quarter-quarter in 2011. The taxon was found in adjoining quarter-quarter sections. While the original colony may no longer be extant at the same spot, it persists throughout the surrounding area.

Areas surveyed but species not located: *Elymus simplex* var. *luxurians* is present in only a fraction of swales across the dune landscape. Surveys for *Elymus simplex* var. *luxurians* were also conducted in the Ferris Dunes in tandem with blowout penstemon surveys (Heidel 2012a) where it was not found (Appendix A). All survey routes in the Killpecker Dunes represent both positive and negative surveys (Appendix B).

Land ownership: All occurrences are on lands administered by the Bureau of Land Management – Rock Springs Field Office. These include lands in the Buffalo Hump Wilderness Study Area, lands designated for off-road vehicle recreation, and checkerboard public lands.

### **Habitat**

*Elymus simplex* var. *luxurians* occurs on eolian sand deposits among shifting sand dunes and adjoining sand plains. It is found in many interdunal swales, and higher in the dune landscape on benches and semi-sheltered positions. Elevation: 6590-7200 feet.

Associated vegetation: *Elymus simplex* var. *luxurians* occupies sparsely-vegetated slopes and flats where it is dominant and the only species present, or part of other sand dune vegetation. In dry settings, it is most often associated with lemon scurfpea (*Psoralidium lanceolatum*) and Indian ricegrass (*Achnatherum hymenoides*). Western wheatgrass (*Elymus lanceolatus* var. *lanceolatus*) is sometimes present in the same habitat, but often in a drier vegetation zone. The eastern Killpecker Dune habitat tends to be more alkaline than the western habitat, and

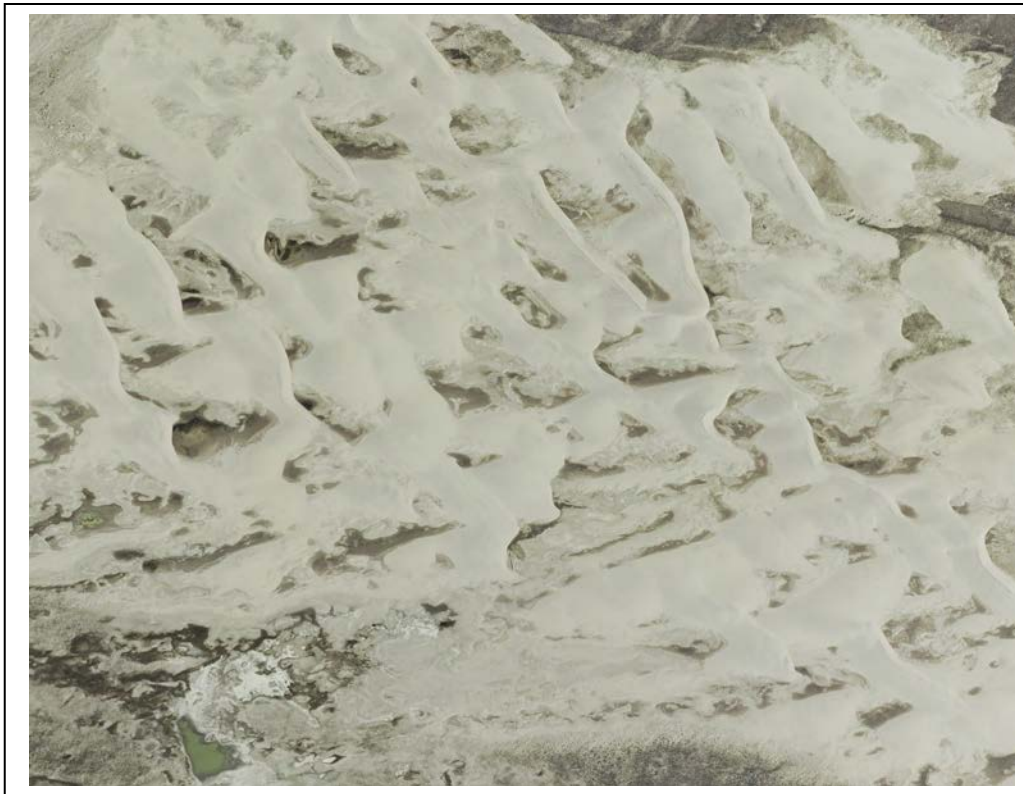


Figure 10. Interdunal swales in the Killpecker Dunes on NAIP imagery (center of EO#004)

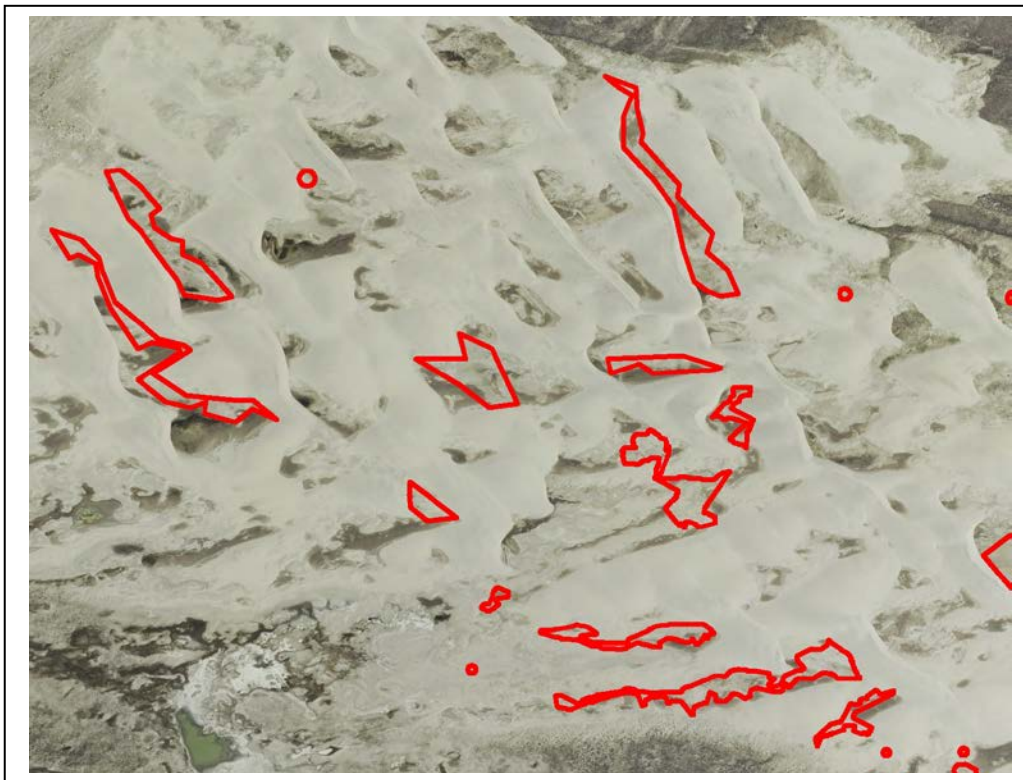


Figure 11. Subpopulation mapping in the Killpecker Dunes (within Figure 18; above).

halophytes were present more consistently, including prickly Russian-thistle (*Salsola tragus*) and greasewood (*Sarcobatus vermiculatus*). Common associates are listed in Table 3.

Table 3. Species associated with *Elymus simplex* var. *luxurians*

Scientific name	Common name
<i>Achnatherum hymenoides</i> ( <i>Oryzopsis hymenoides</i> )	Indian ricegrass
<i>Amphiscirpus nevadensis</i>	Nevada bulrush
<i>Calamagrostis inexpansa</i>	Slim-stem reedgrass
<i>Carex lanuginosa</i> ( <i>C. pellita</i> )	Woolly sedge
<i>Carex parryana</i> var. <i>parryana</i>	Parry's sedge
<i>Chrysothamnus viscidiflorus</i> var. <i>lanceolata</i>	Green rabbitbrush
<i>Cryptantha fendleri</i>	Sand dune cat's-eye
<i>Distichlis stricta</i>	Inland saltgrass
<i>Elaeagnus commutata</i>	Silverberry
<i>Elymus elymoides</i> var. <i>elymoides</i>	Bottlebrush squirreltail
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>	Western wheatgrass
<i>Ericameria nauseosa</i>	Rubber rabbitbrush
<i>Juncus balticus</i>	Baltic rush
<i>Lygodesmia juncea</i>	Rush skeletonplant
<i>Psoralidium lanceolatum</i>	Lemon scurfpea
<i>Rumex venosus</i>	Showy dock
<i>Salsola tragus</i>	Prickly Russian-thistle
<i>Sarcobatus vermiculatus</i>	Greasewood
<i>Spartina gracilis</i>	Slender cordgrass
<i>Triglochin maritima</i>	Common arrowgrass

The most common wheatgrass in upland vegetation plots of the Killpecker Dunes was reported to be *Elymus lanceolatus* var. *lanceolatus* (Jones 2004), and in lowland vegetation plots, *Elymus lanceolatus* var. *riparius* (Jones 2006). There is one plot taken in a separate Killpecker Dunes study (Jones 2002) in which *Elymus simplex* var. *luxurians* was identified as having the highest plant cover of any species in a plot (00SD04.05). The vegetation type was not named for the taxon but simply referred to as the Active sand vegetation type (Jones 2002). This plot falls within 2011 mapping of *E. simplex* var. *luxurians* distribution.

There were no other species of interest found in the same habitat, but target species found in the immediate vicinity included Payson's tansymustard (*Descurainia pinnata* var. *paysonii*) and red poverty-weed (*Monolepis pusilla*). The surveys also targeted blowout penstemon (*Penstemon haydenii*), which was not found. Another species of penstemon that looks superficially similar to the latter is sand penstemon (*P. arenicola*), collected from the Killpecker Dunes area.

The habitat of *Elymus simplex* var. *luxurians* in which plants first become established may change as sands are deposited and eroded. Incremental and catastrophic burials are ongoing, so that the habitat may appear much drier over time than it was originally. For example, there was

one place where a turfy block of *Elymus simplex* var. *luxurians* plants protruded in a horizontal midslope band from an advancing dune wall almost half way up a 10 m dune wall. It is likely that the midslope position represented what had been a swale in the past.

Topography: *Elymus simplex* var. *luxurians* is found most consistently in swales, but is also present in an array of other settings (Figures 10-19). It appears to be most common in the swales of choppy dune landscapes, while also present in lower numbers and possibly lower frequency in the wetlands of rolling sandplains that ring the dunes.

Soil relationships: Soils are poorly developed psamments without profile development or organic matter accumulation. Subsurface moisture persists on flats and sheltered slopes, and locally with springs and seeps. The swale vegetation cover stands in sharp relief to surrounding open sand slopes with their high reflectance, and aerial photographs were found to be highly effective in targeting and prioritizing the most suitable habitat in an area.

Regional climate: The nearest meteorological station is at Farson (1915-2006), an intermontane setting. Mean annual temperature is 37.5° F with mean January temperature at 9.7° F and mean July temperature at 56.5° F. Mean annual precipitation is 7.73 inches, with peak precipitation in May (1.04 in).

Local microclimate: *Elymus simplex* var. *luxurians* occupies areas where soil moisture persists below the surface through most of the growing season. Despite exposed conditions, the whitish sand surface has high albedo and reduces evaporation from underlying soils.

### **Population biology and demography**

Phenology: *Elymus simplex* var. *luxurians* flowers in late June-early July and the spikes mature in mid July, persisting the rest of the growing season.

The 2011 growing season was relatively late, and some spikes were still in flower the second week of July. It is not known if the levels of flowering are consistent between years. The 2011 growing season was also exceptionally moist due to high precipitation in the prior winter and spring, and it was an excellent year to find wheatgrasses headed out.

Population size and condition: The four populations of *Elymus simplex* var. *luxurians* span an area of about 46 miles. It is not possible to determine individuals because the species reproduces vegetatively by rhizomes, at varying density. Frequency was noted instead (uncommon, common, abundant/dominant).





Figure 12. Typical habitat in swales downwind from active dune slopes.



Figure 13. Atypical habitat with high from vegetation cover, in the midst of *Elymus lanceolatus* var. *lanceolatus*.

Figure 14 (below). Lower dune slopes and buried swale bottoms are also occupied.

Figure 15 (right). It is associated with dune pools that form in the steepest terrain.

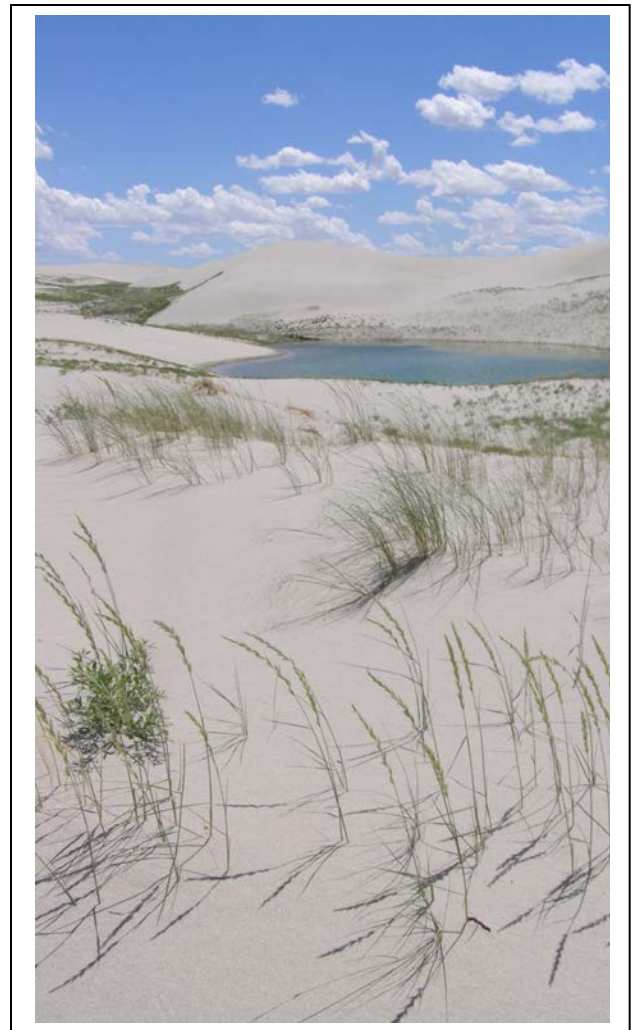
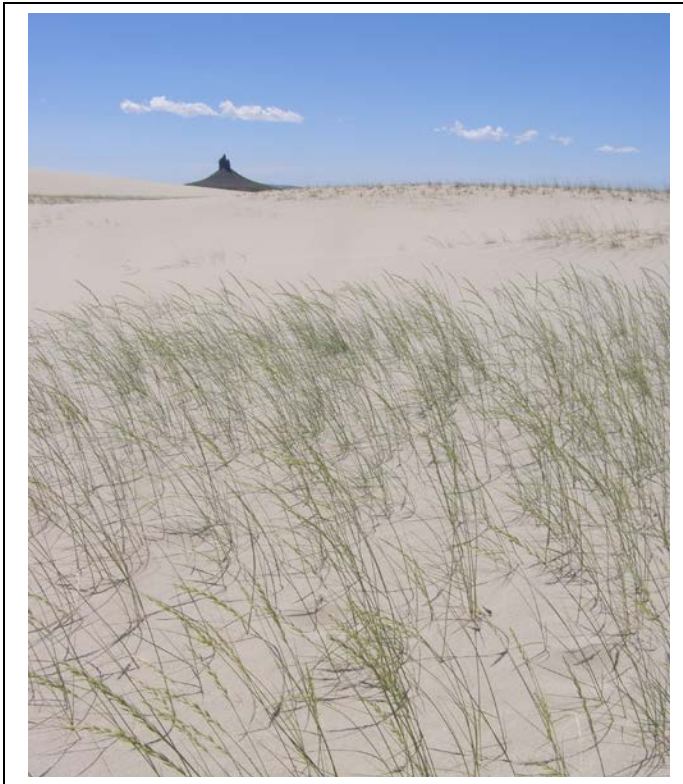




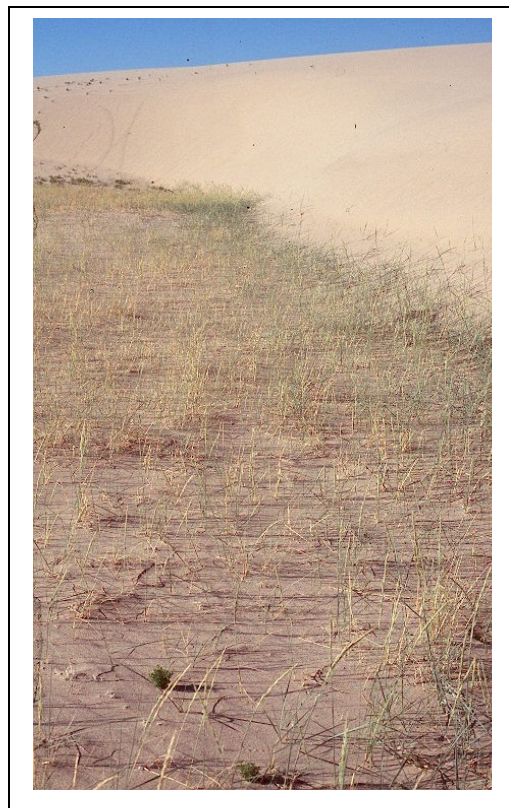
Figure 16. Midslope relict of *Elymus simplex* var. *luxurians*.



Figure 17. Burial of *Elymus simplex* var. *luxurians*.

Figure 18. Rhizomatous growth of *Elymus simplex* var. *luxurians*.

Figure 19. Advancing dune (2006) that buried the plants in this picture by 2011.



Type of reproduction: *Elymus simplex* var. *luxurians* reproduces sexually by seed. All species in the *Leymus* genus are self-incompatible and out-crossing (Barkworth 2007).

It also reproduces by elongate rhizomes, enabling it to expand into unoccupied habitat (Figure 18). Vegetative reproduction may also compensate for burial. A locale was surveyed in 2011 at the identical spot where the author had collected it five years earlier (Figure 19). In the intervening years, the dune had buried the spot that previously had high concentration of plants in 2006, having migrated at least 3-5 m eastward. But the colony had at least partially outpaced the dune encroachment by rhizomatous colonization eastward.

Table 4. Size and extent of *Elymus simplex* var. *luxurians* populations in Wyoming

EO#	Population size <sup>5</sup>	Extent ha (ac)	Number of subpopulations mapped
004	This population has the highest numbers of subpopulations, greatest density of subpopulations, and greatest frequency of it being dominant where present.	5360 (13247)	145 subpopulations
005	This population has the lowest numbers of subpopulations and spans the smallest area.	269 (665)	At least six subpopulations (could be divided into 16)
007	This population spans the greatest area, although in low density.	830 (336)	About 20 subpopulations
008	This population has is intermediate in size and extent, but has the greatest habitat diversity,	5.9 (14.7)	At least 35 subpopulations

Pollination biology: Members of the family Poaceae are wind-pollinated.

Seed dispersal and biology: The chance of *Elymus simplex* var. *luxurians* seeds falling upon surfaces suited for germination late in the growing season is remote because moisture is scarce. It is much more likely that they go dormant and germinate in spring. It is not known whether they require burial to germinate, but it is possible that burial makes subsurface moisture available.

**Population ecology:**

General summary: *Elymus simplex* var. *luxurians* is a perennial that appears to form long-lived clones. There were no signs of recruitment or mortality noted at the time of survey.

Competition: *Elymus simplex* var. *luxurians* is least common where vegetation cover values are highest, suggesting it is a poor competitor. As such, it may be a poor competitor.

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<sup>5</sup> The year in parentheses refers to that of the most complete survey or survey of the largest subpopulation.

Herbivory: No signs of wildlife herbivory have been noted. It is possible that elk and other big game occasionally browse.

Hybridization: Two specimens that appear to be *Elymus simplex* var. *simplex* have been collected in or near the Killpecker Dunes (*Fertig 16159* RM, *Heidel 3543* RM). There are no signs of intermediates, suggesting a genetic distinction (Barkworth 2007). There was a putative hybrid of *Elymus simplex* var. *luxurians* x *E. lanceolatus* var. *lanceolatus* collected (*Heidel 3545* RM) in a place where both species were present. There was a possible hybrid between *E. s.* var. *simplex* x *E. lanceolatus* var. *lanceolatus* in an upland setting not far from *E. s.* var. *luxurians* (*Heidel 3558* RM).

## ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

### **Potential threats to currently known populations:**

Grazing: Most *Elymus simplex* var. *luxurians* habitat in the center of dunes has limited livestock use because it has low forage value and represents secondary range. On the other hand, wetlands at the perimeter of dune landscapes receive concentrated use, though dispersed by the high numbers of wetlands and their extent. Signs of trampling have not been observed and signs of grazing within active dunes were scant and spotty in 2011.

Observations are based on surveys during the exceptionally moist growing season of 2011. This year may not have been representative, and there was more standing water in and around the dunes than ordinary.

Roads: There were no *Elymus simplex* var. *luxurians* locations found beside roads. Most roadways skirt the Killpecker Dunes and roads are subject to burial where they enter the dunes. They may locally or temporarily alter sand migration patterns and drainage, reducing habitat suitability. The raised bed of an abandoned railroad track provides access to the west end of the Killpecker Dunes. The most recent road developments are associated with oil and gas developments. Many of the routes lead to abandoned wells and some are no longer accessible.

There is high offroad vehicle (ORV) traffic in the area designated for ORV use, all of which overlaps with *Elymus simplex* var. *luxurians* distribution. Swales generally have concentrated use by ORV recreationists. However, *E. s.* var. *luxurians* is one of the few plants tall enough in the landscape to get tangled in passing vehicles, and is often anchoring the sand to form slight rises surrounded by loose, unvegetated zones all around, so that the loose sands are favored over the semi-stabilized occupied habitat.

Oil and Gas Development: Abandoned and active oil wells are present around the Killpecker Dunes. There are pipelines running across, below and above open sand surfaces near occupied habitat. There are pump stations surrounded by dune landscape in occupied habitat where plants are growing within short distances. No drilling activity was noted. However, it is not known whether drilling has any affect on the stability of the water table, or if there could be other indirect affects. Another unknown is whether population segments in perimeter wetlands, under greater development pressure, are linked to the interdunal population segments, under little or no development pressure.

Weeds: Non-native species are scarce in *Elymus simplex* var. *luxurians* habitat. The only non-natives noted were (*Alyssum*) and (*Salsola tragus*; syn. ) There is a little Canada thistle (*Cirsium arvense*) in the landscape but not noted in major wetlands.

Quarrying: There were no sand quarrying or mining activities observed in *Elymus simplex* var. *luxurians* habitat.

Over-collection: Both *Elymus simplex* var. *luxurians* and *E. s.* var. *simplex* have received little use in revegetation efforts, though having potential for providing cover, forage, soil stabilization and diversity (Monson et al. 2004).

### **Management practices and response**

*Elymus simplex* var. *luxurians* is adapted to sand dune migration and succession. This confers resilience or positive response to many management practices.

### **Conservation recommendations**

Recommendations regarding present or anticipated activities: There are no immediate threats to *Elymus simplex* var. *luxurians* identified in 2011 surveys. This pertains to its core dune landscape. It is far less common and less consistently present in perimeter wetland settings, but may be more directly affected by management actions in these settings. Further evaluation of the latter may be warranted.

Notification of BLM personnel of locations on BLM lands: To evaluate impacts to known populations, all appropriate BLM personnel involved in on-the-ground management activities that include grazing, weed control, and travel planning should be provided with location data for *Elymus simplex* var. *luxurians*. Toward this end, the updated state species abstract (Appendix C) is provided as part of project products, accompanied by GIS files of all known populations.

Status recommendations: Conservation status is conditioned by taxonomic status, and this study represents a documentation benchmark for further taxonomic research and discussion. *Elymus simplex* var. *luxurians* is retained on the Wyoming species of concern list as a state endemic. The highest

priority for research involves taxonomic investigation confirming all 2011 field determinations of a widespread variety with hybridization as a rare phenomenon. Many species in the *Leymus* genus are allopolyploids and determination of parent species would shed light on genus speciation and variety distinctness.

*Elymus simplex* var. *luxurians* was reranked G3T1T2/S1S2 based on results of 2011 surveys. It may warrant future reconsideration whether it is retained on the Wyoming Species of Concern list (Heidel 2012) or transferred to the list of Wyoming Species of Potential Concern. It may also be further re-ranked once threats information is more thoroughly incorporated into the ranking system.

All known distribution patterns have been documented on BLM lands, while the far eastern end of populations is in a checkerboard of public and private land where the taxon might possibly extend onto private lands. The fact that the type specimen appears to have been collected close to the Green River, outside the Killpecker Dunes was not addressed in survey plans. This may possibly correspond to BLM lands elsewhere in Sweetwater County or on Seedskadee National Wildlife Refuge, warranting survey.

Summary: Systematic surveys were conducted for *Elymus simplex* var. *luxurians* that documented its widespread distribution in the Killpecker Dunes. The number of locations for it was increased by orders of magnitude. What is perhaps more significant in updating results is the near absence of threats to the species and its habitat. However, it is at least remotely possible that oil and gas exploration could signify hydrological changes to its habitat, or that the more vulnerable perimeter wetlands are linked to the interdunal population segments in some basic way.

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